Missouri Space Grant Consortium
Missouri University of Science & Technology
Fathi Finaish
573-341-4699
URL: http://web.mst.edu/~spaceg
Grant Number: NNX10AI92H

PROGRAM DESCRIPTION

The National Space Grant College and Fellowship Program consists of 52 state-based, university-led Space Grant Consortia in each of the 50 states plus the District of Columbia and the Commonwealth of Puerto Rico. Annually, each consortium receives funds to develop and implement student fellowships and scholarships programs; interdisciplinary space-related research infrastructure, education, and public service programs; and cooperative initiatives with industry, research laboratories, and state, local, and other governments. Space Grant operates at the intersection of NASA's interest as implemented by alignment with the Mission Directorates and the state's interests. Although it is primarily a higher education program, Space Grant programs encompass the entire length of the education pipeline, including elementary/secondary and informal education. The **Missouri Space Grant Consortium** is a Program Grant Consortium funded at a level of **$430,000** for fiscal year 2011.

PROGRAM GOALS

The mission of the Consortium is being accomplished through the following objectives:

1. Maintain and expand a network of Missouri universities and corporate partners with interests and capabilities in aerospace and space related science, engineering, and technology.
2. Inspire, motivate, recruit, educate, and train students, especially women, underrepresented minorities, and persons with disabilities, for professional careers in all disciplines of interest to NASA.
3. Promote and enhance a strong science, technology, engineering, and mathematics (STEM) education base from elementary through university levels.
4. Support interdisciplinary education, research, and public service programs involving the STEM fields.
5. Encourage cooperative education and training programs in aerospace and space related science, engineering, and technology among universities, aerospace industry, and other federal, state, and local entities.

Metrics for Measuring Goal Achievement

The proposed efforts of mentoring, teaching, advising, nurturing, and associated scholarly activities will be assessed by the following set of outcomes as can be quantitatively related to NASA's Strategic Education Outcomes 1, 2, and 3:

- Number of Master Theses and Doctoral Dissertations produced.
- Number of Undergraduate Degrees conferred.
- Number of Undergraduate and Honors Thesis produced.
- Number of Journal Articles and Conference Papers published.
- Number of Student Research Paper and Team Competition Awards.
- Number of NASA Field Center and Corporate Internships.
- Number of Teachers and Students participating in Pre-College Programs.
- Number of Persons served in Public Education and Outreach Programs.

PROGRAM/PROJECT BENEFIT TO OUTCOME (1,2, OR 3)

Outcome 1: *Employ and Educate*

The Missouri Consortium's Fellowship & Scholarship, Higher Education, and Research Infrastructure programs strongly address the objectives of NASA's Education Outcome 1. In FY 2011 there were 68 directly supported students participating in independent research, course development, laboratory development, and scientific research group projects. There were an additional 93 indirectly supported students that participated in engineering design team and scientific research group Higher Education projects funded by the MOSGC.

Some particularly exciting Outcome 1 anecdotes are as follows:

The St. Louis University satellite team COPPER took 1st place in the paper & presentation track at the MESCON 2012 conference held at the University of Evansville. Originally selected in 2011 for a flight on the 2012 NASA ELaNa IV (Educational Launch of Nanosatellites) CubeSat mission, the COPPER satellite has been pushed back to launch sometime in 2013. A second CubeSat, Argus, has been selected to fly on a launch opportunity as yet to be determined.

Missouri University of Science & Technology student Samuel Pomeroy, took first place for his oral presentation titled "Electromagnetism surrounding plasmoid formation in an FRC test article" at the 2012 Missouri S&T Undergraduate Research Conference.

A student from Lincoln University of Missouri won second place in a poster presentation competition at the LU Life Sciences meeting held in Jefferson City, MO.

Outcome 2: *Educate and Engage*

Of the seven Pre-College Education programs supported by the MOSGC, there were a total of 264 teacher and 5426 student participants in FY 2011. Projects meant to bring excitement and education to the pre-college participants include Classroom Visits, Planetarium Programs, Summer Space Academy, High School Summer Internships, Middle School Educator Training Projects, Introduction to Aerospace Engineering, and Space Explorers, Inc. Many of these programs are minority student focused with an average of ~60% of the participants being from NASA-targeted under-represented minorities and ~50% female.

Outcome 3: *Engage and Inspire*

Of the five Public Education and Outreach programs supported by the MOSGC, there were a total of 6092 participants in FY 2011. Projects meant to bring inspiration and informal education to the general public include telescope observation and night sky viewing programs, public lectures, and public information services.

PROGRAM ACCOMPLISHMENTS

Directly Supported Student Programs

The Missouri Space Grant Consortium has been conducting highly successful Fellowship and Scholarship, Higher Education Internship, and Research Infrastructure Assistantship programs. The competitive selection of participants is primarily based upon academic achievement and research project merit. This year, 28% the annual program participants were graduate students and 72% were undergraduate students. These students are supported to perform independent mentored research throughout the academic year and summer, including summer internships and academy student placement at NASA Field Research Centers. Students are requested to report the results of their work and present their research at an annual statewide conference. The goal is to provide graduate and undergraduate research training and contribute to the national workforce in the aerospace industry and in space science related fields as needed to achieve NASA's strategic goals to educate and employ.

Fellowships & Scholarships: The Missouri Space Grant Consortium Fellowships are competitively awarded to doctoral and master's degree candidates in aerospace and space related science and engineering. Programs of study must relate to one or more of the NASA Mission Directorates. These awards are normally provided for an entire academic year (Fall and Winter semesters) and are reported annually as part of each Affiliate's Fellowship and Scholarship Program.

Research Infrastructure Assistantships: Both undergraduate and graduate students are competitively selected to assist in the support of Research Infrastructure projects at the Affiliate Institutions. Students work with faculty to develop, maintain, and enhance the capability to perform cutting-edge research at the Consortium's affiliate institutions.

Undergraduate Internships: Summer and academic year Higher Education undergraduate internships are competitively awarded undergraduates in faculty-mentored programs of study that relate to one or more of the NASA Mission Directorates at the Affiliate Institutions.

Puerto Rico Summer Undergraduate in Residence at UMC Nuclear Engineering: This project expands and formalizes the MOSGC's involvement in an on-going partnership between the Nuclear Science & Engineering Institute (NSEI) faculty at UMC and their counterparts at the Polytechnic University of Puerto Rico (PUPR).

NASA Field Research Center and Corporate Summer Programs: Both undergraduate and graduate students are competitively selected by NASA Centers and corporate partners to participate in these programs. These students travel to NASA Centers and corporate facilities to perform independent research under the guidance and mentorship of

professional engineers and scientists. The Consortium supported six NASA Center summer interns and one Corporate summer intern in FY2011.

The students who have been selected by the Consortium, NASA Centers, and Corporate partners have generally been outstanding in their academic capabilities and impressive in their accomplishments. They have authored and co-authored many published papers and have presented their work at a multitude of professional meetings. In FY2011, Missouri Space Grant's directly supported students produced a total of 23 journal and conference publications in addition to 44 MOSGC technical reports that were presented at the Consortium's annual statewide meeting in April. Furthermore, three students will be awarded MS degrees and two will earn PhD degrees this year.

Higher Education Engineering Design Teams and Scientific Research Groups: The Affiliates of the Missouri Space Grant Consortium are involved in a wide range of activities that are designed to promote a strong science, mathematics, and technology base at the university level. To greatly enhance the MOSGC's contribution to Outcome 1, support is provided for several design team projects and scientific research groups on the Affiliate campuses; thereby opening opportunities for groups of post-secondary students to engage in authentic NASA-related mission-based R&D activities. These projects also have a significant potential to attract and retain students in STEM disciplines through a progression of educational and hands-on research and development opportunities for students, teachers, and faculty as desired in Outcome 2. The Consortium also invested in the curriculum development of NASA-related course resources for integration into STEM disciplines at the university level as indicated by Outcome 1. This section briefly describes the Consortium's higher education team and group activities in 2010-2011:

- S*ociety of Automotive Engineers (SAE) AeroDesign East Competition* - The Missouri S&T Advanced Aero Vehicle Group took third place in the heavy lift aircraft class at the SAE Aero East competition in Marietta, GA on April 27-29. The governing design concepts focus around the aircraft's ability to carry a large payload fraction while limited to a total weight of 55 pounds.
- *University Student Launch Initiative (ULSI) Competition* - The Missouri S&T Advanced Aero Vehicle Group participates in the University Student Launch Initiative run by NASA every year. The competition calls for teams of students to design and build a reusable, high power rocket targeting one mile altitude while carrying a scientific payload. This year a team from Saint Louis University also participated in the competition. Launch day was on April 22, 2012, in Huntsville, AL.
- *NanoSat-7 Competition Teams* - The Missouri Consortium is supporting two NanoSat-6 competition teams in FY 2011, one from MS&T and one from SLU. The Nanosat-7 Program (NS6) is a joint Air Force Research Laboratory and AIAA activity and eleven schools made the final selection to participate in this 24-month satellite design competition. The Nanosat-7 Proto-Qualification Review (PQR) will be held August 13, 2012 on the USU Campus in Logan, UT.
- *Grant Us Space Micro-Gravity Flight Opportunities* – Two proposals from MOSCG affiliated universities were selected for flight in FY 2011. A project from Drury University in Springfield Missouri involves testing a robotic arm in

micro-gravity and the Miners in Space team at Missouri S&T will be evaluating cardio resuscitation techniques in the weightless environment. Both flights are scheduled for summer 2012.

- *The "Pathfinder" Collegiate Undergraduate Program* - The Pathfinder Program at Washington University in St. Louis involves the use of remote sensing data sets and analysis techniques applied for both environmental sustainability and for the study of terrestrial terrains as analogs for other planetary surfaces. This program is a four-year experience involving a small group of highly motivated students of exceptional academic caliber, a senior faculty member, and a research team that is actively involved with environmental studies. The program utilizes case studies and field-oriented approaches to introduce students to issues surrounding environmental sustainability and the duty to preserve the environment for future generations
- *Strengthening the Multidisciplinary Astrobiology Research Community* - The goal of this project was to bring together faculty and undergraduate students from four diverse disciplines to create a new astrobiology-themed research community at Truman State University. Research teams worked independently on astrobiologically relevant projects, and came together at weekly community-building events to share knowledge across disciplines and to foster a sense of shared purpose. Students and faculty supported by this project had the opportunity to increase their exposure to astrobiology through field trips to a research observatory, NASA Field Centers, and a major astrobiology conference.
- *The 21st MOSGC Annual Spring Meeting* was held on April 29-21, 2012, on the Missouri S&T campus. This meeting featured 42 oral presentations and 17 poster presentations from the Consortium's Fellowship & Scholarship and Higher Education students.

Pre-college Education Programs

The primary goal of the Consortium's Pre-college Education Program is to expose aerospace and space related science, technology, and engineering topics to young students in such a way as to be an enjoyable learning experience; leaving students, parents, and teachers with a better appreciation for and understanding of these disciplines. The Consortium's approach to many of these activities is to assist pre-college educators with developing and presenting programs and activities. The assistance may include use of technical/scientific staff and facilities, logistical support, and modest amounts of funding for program materials. The list of projects supported in FY 2011 is as follows:

- *High School Summer Internships*
- *Classroom Visits*
- *Planetarium Programs*
- *Columbia Area Space Association*
- *Summer Space Academy*
- *Middle School and Informal Educator Training*
- *Introduction to Aerospace Engineering*
- *Space Explorers, Inc.*

Informal Education Programs

Of the six MOSGC supported Informal Education programs, there were of approximately 6,000 participants in FY 2010. With the matching funds provided by the Consortium's Affiliates, industry, and local communities, it was possible to provide excellent service to the general public. Of particular value is the extensive outreach to underrepresented minorities through these outstanding programs. The successfulness of these programs is measured primarily by the high number of participants for a relatively low investment cost. The following Space Grant supported activities are currently being conducted:

- *Telescope Observing Sessions* at MSU, UMKC, UMSL and Washington U.
- *Monthly Aerospace Lectures*
- *Space Science Information Service*

PROGRAM CONTRIBUTIONS TO PART MEASURES

- Student Data and Longitudinal Tracking:
  - Total Direct Student Awards = 68
  - Fellowship/Scholarship Awards = 21
  - Higher Education Internship/Research Infrastructure Assistantship Awards = 47
  - Indirectly Supported Higher Education Engineering Design Team and Scientific Research Group Students = 93
  - 5 of the total awards represent underrepresented minority F/S funding.
  - 8 of the total awards represent underrepresented minority HE and RI funding.
  - 7 under-represented and under-served students participated in indirectly supported HE engineering design team and scientific research group programs.
  - 11 of this year's program student participants will be employed by NASA, aerospace contractors, universities, or other educational institutions.
  - 9 undergraduate students will move on to advanced education opportunities in NASA-related disciplines.

- Diversity:

The Consortium exceeded the Fall 2010 NCES NASA-targeted underrepresented minority statistic for all Missouri Institutions higher learning of 18.4% with an average targeted minority participation of 19.1% for the 68 directly supported students. The Consortium fell short of its female participation level target of 40% with 33.8% of the directly supported students being women. There were a total of 93 indirectly supported students of which 7.5% were from underrepresented minorities and 35.5% were women. The Pre-College participants were approximately 60% minority and 50% female. The Informal Education participants were approximately 40% minority and 45% female.

- Minority-Serving Institutions:

The Missouri Consortium continues to support activities at Lincoln University of Missouri in Jefferson City. Affiliate/Associate partnerships to involve Harriet-Stowe College in St. Louis are still under consideration. Since Harriet-Stowe does not offer technical programs, ancillary opportunities in education, journalism, web-design, and graphic arts are being contemplated.

- NASA Education Priorities:

As indicated by the above program accomplishments, the Missouri Consortium's efforts are aligned with NASA's education priorities, which include STEM workforce development, student-led projects, intensive summer learning opportunities for middle school teachers/students, and opportunities to develop and strengthen ties to NASA Centers and/or Mission Directorates.

Each of the specific NASA Education Priority related projects supported by the Consortium are given below:

- All Fellowship and Scholarship, Higher Education, and Research Infrastructure projects provide authentic, hands-on experiences for students in science and engineering disciplines.
  - F/S: Nine projects at seven Affiliate/Associate Institutions.
  - HE Internships: Ten projects at eight Affiliate/Associate Institutions plus one project for NASA Field Research Center summer internships.
  - RI Assistantships: Two projects at two institutions (MST and WashU-EPSci).
  - HE Engineering Design Teams and Scientific Research Groups: Seven engineering design teams at four institutions (MS&T, SLU, WJC, and WashU-MEMS). Two scientific research groups at two institutions (TSU and WashU-EPSci)
- Middle school teacher engagement in hands-on curriculum enhancement capabilities through exposure to NASA-related scientific and technical expertise: Four projects at four institutions (MST-SEI, MSU, UMSL, SLCLC).
- Summer opportunities for secondary students on college campuses with the objective of increased enrollment in STEM disciplines or interest in STEM careers at four institutions (MST, MSU, UMC, UMSL).
- Community College engagement is under development at two institutions (MST and WashU-MEMS). Other opportunities are being explored at UMKC and UMC.
- Aeronautics research, in traditional aeronautics disciplines, is primarily being performed by F/S and HE students under faculty mentorship at MST, UMC, and Wash-MEMS. One HE/RI project under development at WashU-MEMS is geared to directly address a fundamental research need of the Next Generation Air Transportation System (NextGen).
- One HE Internship project at MSU and one HE Scientific Research Group project at WashU-EPSci pursue Environmental Science and Global Climate Change research and activities to better understand Earth's environments.
- The diversity of institutions supported by the Consortium vary widely in both economic and ethnic population bases. The state's only HBCU offering STEM degrees, Lincoln University of Missouri, supports undergraduate scholarships and internships under the supervision of three faculty members. The diversity of the Consortium's faculty is consistent with the faculty diversity within the participating institution's departments. The overall diversity of directly supported student participants exceeds the state-wide statistics for NASA-targeted minorities as most recently provided by the NCES. Please see the bulleted diversity sections

above for more details regarding the Consortium's efforts to maintain a diverse culture of participants.

- The enhancement of the capacity of the Consortium's institutions to support innovative research infrastructure activities is being pursued at four of the participating universities (MST, MSU, UMSL, and WashU). Two projects specifically intended to enable early career faculty to focus their research toward NASA-related priorities are being supported at MST and UMSL.

IMPROVEMENTS MADE IN THE PAST YEAR

The primary improvement made by the Missouri Consortium in FY2011 was the executive board's acceptance of a proposal to fully fund the University of Missouri – Kansas City. The UMKC Affiliate will now be funded at the same level as the other permanent Affiliates.

PROGRAM PARTNERS AND ROLE OF PARTNERS IN PROJECT EXECUTION

The Missouri Space Grant Consortium is composed of the Lead Institution, six Affiliates, and three Affiliate Candidates with an even balance of science and engineering disciplines that have specialization in research areas of interest to NASA. Each member institution pursues projects that best suit their unique capability and contribute the overall success of the Consortium, as summarized in the Outcomes section above. The Affiliates have been highly effective in promoting and executing NASA related opportunities on their campuses and in their local communities, which is considered one of the Consortium's greatest strengths. Some of the Affiliates collaborate in Space Grant activities with Associate Members of the Consortium. Furthermore, the Affiliates are being encouraged to seek out and join with organizations of common interest to increase the number of Associates and thereby extend the scope and reach of the Consortium. The list of current MOSGC Affiliate, Associate, and Affiliate Candidate Members and, along with their core departments is as follows:

Affiliate Members:

- Missouri University of Science & Technology (MS&T - Lead Institution)
  Department of Mechanical and Aerospace Engineering
- Missouri State University (MSU)
  Department of Physics, Astronomy, and Materials Science
- University of Missouri – Columbia (UMC)
  Department of Mechanical and Aerospace Engineering
  Nuclear Science and Engineering Institute
- University of Missouri – Kansas City (UMKC)
  Department of Civil & Mechanical Engineering
- University of Missouri - St. Louis (UMSL)
  Department of Physics and Astronomy
- Washington University in St. Louis (WashU)
  Department of Earth and Planetary Sciences

Department of Energy, Environmental, and Chemical Engineering
Department of Mechanical Engineering and Materials Science

- St. Louis Science Center (SLSC)
  James S. McDonnell Planetarium

Consortium Associate Members:

- Lincoln University of Missouri (HBCU)
- St. Louis Challenger Learning Center
- St. Louis University
- Truman State University
- William Jewel College

Affiliate Associate Members:

- St. Louis Astronomical Society (WashU-EPSci)
- St. Louis Gifted Resource Council (WashU-EPSci)
- Spaceweek-St. Louis (WashU-EPSci)
- The Space Museum of Missouri (WashU-EPSci)
- Columbia Aeronautics and Space Association (UMC)
- Drury University (MS&T)